Method and device for treating flat and flexible work pieces

Specification:

The device and the method serve to treat flat and flexible work pieces, preferably in electroplating lines and etching facilities, more specifically when foil-type work pieces are immersed vertically in a treatment bath during wet-chemical or electrochemical processes.

Methods of treating particularly thin work pieces such a printed circuit foils in wet-chemical processing lines, electroplating lines and etching facilities include, but are not limited to, the method steps of cleaning, activating, electroplating and post-treating said printed circuit foils. In a work piece, the inside of which is made of an electrically non-conductive material, a printed circuit pattern and through-plated holes are produced in several treatment steps. For special applications, the thickness of the foils amounts to no more than 30 - 50 μm so that these foils are highly sensitive to mechanical stresses. The surface is often soft so that the work piece cannot be conveyed between rollers. In this case, vertical processing lines, such as electroplating lines for example, are utilized. In these lines, the printed circuit foils are fastened for transport by their outer edge to a flight bar by means of clips, clamps or screws. Generally, a plurality of foils are disposed on a flight bar, in a row side by side, and sometimes also one beneath the other.

For the electrolytic deposition of a conductive layer, the work piece is connected to the negative pole of a current source via the clamps and a flight bar. A counter electrode, an anode in this case, is accordingly electrically

conductively connected to the positive pole. During electrolytic etching, the polarities are interchanged. The work pieces are then anodically polarized.

The flight bar to which the work pieces are fastened is held on a conveyor carriage so that the work piece is transported from one immersion bath to another, where it can be lowered into the respective one of the immersion baths and lifted out of it again after treatment.

The treatment baths used for different processes are operated with aqueous fluids. Depending on the composition, said fluids have different surface tensions. To lower the thin work pieces, *e.g.*, the foils, into the treatment baths, they need to have a minimum rigidity and a surface as level as possible. If this is not the case, the foils can be deviated as they are being lowered into the fluid, for example in the horizontal direction because of the surface tension of the fluid, and can hit the rim of the tank or component parts located nearby such as anodes, heating apparatus, cooling devices, sensors and the like.

Too strong a deviation may entail the risk that these sensitive foils will deform or bend and even the risk of creating a short in electrolytic baths when the deviated foil is caused to touch an electric antipole. The reason therefore is the poor guiding of the work pieces by the clamps or racks, or the lack of rigidity of the material. Flows in the bath fluid, which are induced by circulation pumps, air injection and the like (convection), can also deviate the foils. With the ongoing requirement to reduce the thickness of the work pieces, they can no longer be immersed like conventional, thicker work pieces.

It is an object of the present invention to avoid the disadvantages of the known methods and more specifically to provide a device and a method for treating flat and flexible work pieces that ensure, at little expense secure, lowering of the work pieces into a processing fluid without causing damage thereto.

The present invention provides the device according to claim 1 and the method

according to claim 14. Preferred embodiments of the invention are recited in the subordinate claims.

Before the present invention of treating flat and flexible work pieces into a processing fluid without causing damage thereto is disclosed and described, it is to be understood that this invention is not limited to the particular device, process steps and materials disclosed herein as such devices, process steps and materials may vary somewhat. It is also to be understood that the terminology used herein is used for the purpose of describing particular embodiments only and is not intended to be limiting since the scope of the present invention will be limited only by the appended claims. Therefore it is to be understood that various modifications and substitutions by technically means may be applied to what will be described by way of the examples and of the drawings herein below, without departing from the scope of the invention as defined by the appended claims.

The device according to the invention and the method serve to treat with a fluid substantially vertically positioned, flat and flexible work pieces in particular, preferably in electroplating lines and in etching facilities. The device and the method permit to place foil-type work pieces in particular in such a manner into the fluid, a processing fluid (treatment bath) for example, that they will not deform and/or substantially shift position so that they are prevented from hitting the side walls of the processing tank (tank) or other built-in components.

The device in accordance with the invention comprises at least one protective carrier for holding the work pieces, which carrier may be received by a tank containing the fluid, and at least one means that enables the fluid to flow into the protective carrier in such a manner that the work piece within the protective carrier will not deform and/or substantially shift position, at least not during the inflow of the fluid and the filling process. Preferably, the fluid is a processing fluid for wet-chemical or electrochemical treatment. The fluid used may also be a gas, for example heated air for drying. For simplification sake, the term

„processing fluid“ will be used in the following description to designate any fluid.

For carrying out the method in accordance with the invention, the work pieces are fastened to a flight bar for example, said flight bar conveying the work pieces by means of a transport system to the various processing tanks. In accordance with the invention, the work pieces are thereby not lowered into the fluid but are at first received in a protective carrier that has for example been largely emptied of processing fluid. The protective carrier is transferred to the processing tank in which it is disposed. Then, the protective carrier is filled with the processing fluid in such a manner that the work piece will not substantially deform and/or shift position. Only then will the work piece be contacted with the processing fluid and be treated.

The protective carrier consists of a material which is suited for the chemicals used and for the intended bath temperatures, such as *e.g.*, a plastic material or a metal. The means provided for admitting the processing fluid in the protective carrier using gravity forces is at least one aperture in the protective carrier. The protective carrier is preferably comprised of side walls and of a bottom wall, the apertures being evenly spaced and distributed in said walls. The apertures are dimensioned in such a manner that the processing fluid controlledly and slowly flows into said carrier without bending or pushing away the sensitive work piece. The size (flow passage area) of each aperture preferably ranges from 1 to 500 square millimeters. In order to take into consideration specific requirements such as different surface tensions of the processing fluids used, which may vary depending on the composition of the processing fluid, or the sensitivity of the work pieces, the apertures in the protective carriers can be manufactured differently or be adjustable. The flow passage areas of the apertures may for example be varied and adjusted by way of displaceable shutters or orifice plates. Said shutters or orifice plates can be mounted to the walls of the protective carrier. By displacing the shutters or orifice plates relative to the apertures, the position of the apertures in the orifice plates relative to the position of the apertures in the walls of the protective carrier can be varied, the

openings in the protective carrier being partially covered or closed. As a result thereof, the fluid entering the protective carrier and the speed of the volume flow of this fluid can be varied. By partially closing the apertures in the protective carrier by displacing the shutters and orifice plates, the inflow per unit time is reduced.

As a function of the flow velocity for example, turbulence occurs in the processing fluid behind the apertures in the protective carrier during inflow of the processing fluid into the carrier. Additionally, discrete flows form which, taking departure from the openings, are oriented toward the interior of the protective carrier and also create turbulence as they meet. These turbulent flows can cause the sensitive work piece to be deformed. The extent of the effect produced by the turbulence onto the work piece depends for example on the orientation of the work piece relative to, and on its distance from, the occurring turbulence or the flow direction. In a specific embodiment of the protective carrier, the processing fluid only passes through the apertures in the side walls of the protective carrier that are oriented parallel to the work piece, while possibly existing apertures in the other side walls are closed. This provision is intended to prevent work pieces that are particularly prone to deformation from bending since the flows, which in this case impinge almost frontally on the work pieces, cancel out each other so that the work pieces will not substantially deviate from their position.

For fast evacuation of the processing fluid from the protective carrier after treatment, for example during the lifting of the carrier, the bottom wall of the protective carrier can be preferably provided with drain baffles or large surface drain gates that automatically open when the protective carrier is being lifted, *e.g.*, through the lift motion via lever rods or through floats, and automatically close again as it is lowered into the tank.

During the electrochemical treatment (by an electroplating or electrochemical etching process) of the work piece, the anodes needed for electroplating to

form the electrolytic cell, or the cathodes for etching, can be fastened to the walls of the protective carrier, more specifically when said anodes are *e.g.*, insoluble. If the chemical resistance of the protective carrier material and the electrochemical process are appropriate, the walls themselves can perform the function of the anode or cathode.

If the anodes (counter electrodes) are fastened in a manner well known in the art on either side of the work piece in proximity to the rim of the tank, the protective carrier can perform the function of shielding a counter electrode against electrical field lines in addition to that of protecting the work pieces against convective flow in the protective carrier. For this purpose, the apertures, bore holes for example, in the protective carrier for admitting the processing fluid may for example preferably not be provided in the perimeter region of the protective carrier walls or they may be smaller in diameter and/or reduced in number in these regions than those in the center regions of the walls. This permits to avoid the undesired high field line concentration in the perimeter region of the work pieces. In this case, the material of the carrier is not allowed to have features of electric conductivity, at least on the surface thereof, as the electric field lines are otherwise not capable of penetrating into the carrier and of reaching the work pieces.

To fill the protective carrier after the work pieces have been received therein or as they are being introduced into the protective carrier, the processing fluid is delivered to the protective carrier through a hydrostatic gradient created through different bath levels inside and outside the protective carrier. There are various possibilities to create this gradient as a result of the difference in fluid levels inside and outside the protective carrier, the fluid in the processing tank may for example be displaced as the protective carrier is lowered into the tank.

A processing tank may for example be comprised of a stationary, *i.e.*, firmly mounted protective carrier. In this case, the work piece held on the flight bar is transferred into the empty protective carrier located in the empty tank using a

transport system. In this case, the processing fluid is for example contained in a separate reservoir prior to lowering the flight bar into the empty tank and is delivered to a tank space located outside the protective carrier using a delivery system (a pump system or gravity) and conduits after the flight bar has been completely lowered into the work tank and the work pieces have been deposited in the protective carrier. Upon completion of the wet-chemical or electrochemical treatment, the work pieces are lifted from the tank by means of the transport system and are transported to the next processing tank. The processing fluid is recirculated to the reservoir. Then, the protective carrier is ready for receiving the next work pieces.

In another embodiment, the fluid level difference in the tank can be obtained by lowering the protective carrier holding the work pieces into the tank, with the processing fluid being delivered to the tank only during or after lowering of the carrier. In this case, the processing fluid is for example contained in a separate reservoir and is delivered to a tank space located outside the protective carrier using a delivery system (a pump system or gravity) and conduits after the flight bar with the work pieces has been completely lowered into the tank or during lowering thereof. The reservoir can either be placed next to the work tank as a separate unit or be formed by a separate side compartment in or on the processing tank. Apparatuses for processing the processing fluid such as *e.g.*, stirrers, heaters, coolers or the like can be mounted in the reservoir. Upon completion of the chemical or electrochemical treatment, the flight bar with the work pieces is lifted out of the tank and the processing fluid can concurrently be recirculated to the reservoir.

In another embodiment, the fluid level difference in the tank which has already been filled with processing fluid can be obtained by lowering the protective carrier into the processing tank already holding the work pieces.

The above mentioned method and device variants regarding alternatives for transferring the protective carrier into a tank that has, or has not, been filled

with processing fluid can be combined *ad lib* with the embodiments described herein after, said embodiments being directed to the way of transferring the protective carrier into the processing tank and of removing it there from:

The protective carrier can be lowered into the for example filled processing tank using various means. The means can preferably be comprised of a stationary protective carrier hoist that is associated with the tank and by means of which the protective carrier is conveyed into the tank. In another preferred exemplary embodiment, a protective carrier hoist which is mounted to a transport carriage of the transport system for conveying the work pieces can transfer the protective carrier into the tank.

In the case of a stationary protective carrier hoist, the hoist lifts the protective carrier into an upper position before the flight bar is lowered into the processing tank. In this position, the protective carrier has been taken out of the processing tank so far and processing fluid has thereby flown out to such an extent that the work pieces will not be immersed into the processing fluid as they are being lowered into the protective carrier. For the purpose of causing the processing fluid to flow out quickly after treatment, drain baffles or large surface drain gates provided in the bottom of the protective carrier can for example open as the protective carrier is lifted, said drain baffles or drain gates opening automatically through the lift motion by way of lever rods or through floats and closing automatically again through the lowering motion. Of course the frain baffles and drain gates may also be open and closed by means of motors or any other actuation, such as by hand.

For treatment, the protective carrier and the work pieces are preferably synchronously lowered into the processing tank. The fluid held in the processing tank is thereby displaced to such an extent that the fluid level in the tank increases, resulting in a difference in fluid level within and outside the protective carrier. As a result thereof, the processing fluid is allowed to uniformly flow through the apertures provided into the protective carrier without

the work pieces being damaged thereby. The flow passage area of the apertures can thereby be adapted for example to the speed at which the hoist lowers the work pieces by varying the flow passage area of the apertures using the shutters in the side walls of the protective carrier for example in order for the inflowing processing fluid to controlledly flow in, in conformity to the properties of the work pieces. After treatment, the work pieces can, as is usual with such facilities, be directly removed using a transport carriage hoist of the transport system. Then, the work pieces are conveyed to the next processing tank through the travel motion of the transport carriage. The protective carrier remains in the lower position in the processing tank until the next work pieces are ready and waiting above the processing tank in order not to hinder the travel motions of the transport carriage.

In a specific embodiment of this variant of the invention, the work piece hoist, which is normally mounted to the transport carriage, may be dispensed with, a hoist for the protective carrier and for the work pieces being mounted to each processing tank in this case. After the hoist has lifted the work pieces out of the station and has brought them into the upper position, the arriving transport carriage receives the work pieces placed on the flight bar. The protective carrier, which has also been lifted, is lowered again with this hoist and the flight bar, which is now freely hanging, can for example travel to the next processing tank. There, the protective carrier belonging to that tank is lifted, receives the flight bar and lowers it into the processing bath. Then, the transport carriage can travel to the next work station.

If a protective carrier hoist is mounted to the transport carriage, the protective carrier can be lowered and lifted in and out of the processing tank using said hoist. For this purpose, the transport carriage conveys the work to be treated to the processing tank. Prior to loading the wet-chemical bath, the protective carrier is stored in the respective one of the processing tanks. As is usual with such type dip plants, the transport carriage arrives at the processing bath with the work to be treated in a lifted condition. Unlike prior art methods, by which

the flight bar is immediately lowered into the processing tank, the invention suggests to at first lift the protective carrier out of the processing tank with the protective carrier hoist to such an extent that the work pieces are thus received by the largely empty protective carrier. Then, the flight bar and the protective carrier are slowly lowered at substantially the same speed into the processing fluid of the processing station. The processing fluid is thereby uniformly delivered to the protective carrier holding the sensitive work pieces during the lowering thereof into the tank, without causing deviated or deformed work pieces. To remove them, only the flight bar with the work piece hoist is lifted. The protective carrier hoist on the transport carriage and the protective carrier in the tank remain in the lower position and the transport carriage travels to the next processing station. This embodiment permits to manage without a stationary hoist for the protective carrier on the processing station, the required overall height almost corresponding to the need of prior art dip plants.

In a specific embodiment of this variant of the invention, the protective carrier is fastened to the transport carriage so as to be vertically movable and travels, together with the work pieces, to the respective one of the processing stations. The protective carrier is configured in at least two parts and has, on the bottom and on two opposite side walls, automatically actuatable baffles capable of opening the protective carrier at the bottom and on the sides when the need arises. Once the baffles are open, the protective carrier is separated in two halves that are hanging parallel to each other, that are fastened on the transport carriage and that are no longer completely surrounding the flight bar with the work pieces. Preferably, the work pieces and the two halves are oriented substantially parallel to each other. For receiving the work pieces, the work piece hoist or the flight bar hoist, which is additionally provided on the transport carriage, pulls the flight bar holding the work pieces into the open protective carrier as said flight bar is being lifted. Once the flight bar holding the work pieces has reached the upper position, the bottom and side baffles are closed and the two carrier halves are combined to form a closed carrier. In this condition, the transport carriage travels to the next processing station where it

lowers the closed protective carrier with the flight bar and the work pieces into the processing station. Once the processing fluid has completely entered the protective carrier, meaning once the bath level is almost the same inside and outside the protective carrier, the bottom and side baffles are opened and the protective carrier is again lifted by the protective carrier hoist until the upper position, the transport position of the protective carrier, is reached. The work pieces are treated and the transport carriage, together with the protective carrier, resumes travel in order to execute the next transport mission. In order for greater turbulent flows in the bath fluid not to cause the sensitive work pieces to be strongly deviated during the lifting process of the protective carrier, the side walls and the baffles must be configured accordingly to allow for convenient flow, for example with rounded edges, smooth surfaces and without protruding parts. With this embodiment it is not necessary to equip each processing station with a protective carrier, but this feature also has the disadvantage that processing fluid adhering to the protective carrier is taken to the next station respectively. This drawback can be mitigated by for example a wiping or a blowing off apparatus provided on the transport carriage, said apparatuses being capable of removing, or at least of substantially reducing, the amount of adhering fluid during the lifting process. This embodiment is particularly well suited for cases in which entrained bath fluid will not involve great disadvantages, *e.g.*, for the transport from one rinsing bath to the next, for conveying the work pieces to processing baths of very similar compositions, *e.g.*, multistage cleaning baths, or for cases in which continuous drag-out of processing fluid, *e.g.*, for rejuvenating the bath composition, is even wanted. The closed baffles at the bottom of the protective carrier can concurrently serve as a drip pan during the travel of the transport carriage. The processing fluid, which has preferably been shaken off by the travel motion, is collected by the closed baffles. As the baffles open at the following processing station, this residual fluid can be evacuated. For this purpose, collecting hoppers may be provided which prevent any residual fluid from not flowing into the processing station instead of being led *e.g.*, directly to a waste water treatment system.

In a further embodiment of the invention, the protective carrier will not remain in the treatment bath after treatment. The protective carrier can for example be mounted to the flight bar, which also holds the work pieces. For loading and unloading the work pieces, the protective carrier is provided with doors on a side thereof that faces the loading and unloading station. In this embodiment, the flight bar, together with the protective carrier, is brought to the respective one of the processing stations where it is slowly lowered into the bath. During the lowering process, the processing fluid uniformly flows into the protective carrier without deforming the work pieces. With this embodiment, the equipment expense is very low but, on the other side, the amount of entrained processing fluid originating from residual fluid adhering to the walls and apertures of the protective carrier and being taken along from one bath to the other is much higher.

As a matter of fact, various embodiments of the invention can be combined together within an electroplating plant.

The device according to the invention and the method will be explained further with respect to the figures. The discrete processing stations (tanks) in the figures are shown in a cutaway side view. In the drawing:

Fig. 1: is a side view of a row of tanks with and without protective carriers and with a reservoir in an electroplating plant;

Fig. 2: is an enlarged side view of a tank with a stationary protective carrier and with a reservoir directly mounted thereon;

Fig. 3: is a schematic illustration of a tank array in an electroplating plant with a stationary protective carrier hoist;

Fig. 4: is a schematic illustration of a processing station in an electroplating plant with a tank and with a protective carrier hoist disposed on a transport carriage.

Fig. 1 illustrates various processing stations **10**, each being comprised of tanks

3, 3' or 24. The tank 3' is connected to a reservoir 7 via conduits 9 and a pump 8. A stationary, *i.e.*, firmly mounted, protective carrier 5 with apertures 6 is associated with the tank 3'. By contrast, a liftable and lowerable protective carrier 5 with apertures 6 is associated with tank 3. A transport system for transporting the work pieces 1, which substantially consists of a carrying arm 23, a flight bar 2 and a holding device 4, is assigned to each processing station. The work piece 1, which is in the present case a thin printed circuit foil, extends perpendicular to the plane of the drawing. The flight bar 2, a rectangular copper rail for example, is illustrated in the same manner with a carrying arm 23, a transport carriage (not shown) receiving the flight bar 2 and conveying it to the discrete processing stations 10 of the electroplating plant. The work pieces 1 are fastened to the flight bar 2 by means of the holding device 4. In this arrangement, no protective carrier 5 is associated with the tank 24. The treatment intended to be carried out here can for example be performed in a gaseous environment so that a protective carrier 5 is normally not needed. If strong flows are generated during this treatment, for example air circulation by means of powerful fans, the protective carrier 5 can also be utilized here, with the apertures 6 thereof being adjusted accordingly.

Through the openings 6 in the side walls of the protective carrier 5 the processing fluid is circulated at controlled speed to the protective carrier 5. In the processing condition, the tanks 3 and 3' are filled with processing fluid up to the bath level 21.

The tank 3' is loaded for treatment with the work pieces 1 to be treated, the processing fluid being at first held in the reservoir 7. For loading, the work pieces 1 are conveyed by a transport carriage to the processing tank 3' and are lowered into the protective carrier 5 and into the tank 3' which are both empty at this instant of time. Then, the processing fluid is pumped with pump 8 from the reservoir 7 through the conduits 9 into the tank 3'. The tank 3' is filled with processing fluid. This concurrently leads to a difference in the fluid levels inside and outside the protective carrier 5, which results in a controlled flow of the

processing fluid through the apertures **6** into the interior of the protective carrier **5**. The speed of the fluid flowing into the protective carrier **5** is determined as a function of the output capacity of the pump **8** and by the size of the apertures **6**. In practice, it ranges from 0.01 to 1 m/s maximum. During treatment, the protective carrier **5** also has to perform the function of keeping stronger flows, as they are *e.g.*, generated by filter circuits or stirring devices used for uniform temperature distribution or for distribution of the replenishing solutions, away from the work pieces **1**.

After treatment, the flight bar **2** holding the work pieces **1** is lifted out of the processing fluid using a hoist (not shown), which is mounted to the transport carriage and is brought into a rinsing station for example for subsequent treatment. Concurrently, the processing solution is recirculated to the reservoir **7** either with pump **8** by switching valves (not shown) or by taking advantage of a height difference between the tank **3'** and the reservoir **7**.

For treating the work pieces **1** in tank **3**, the protective carrier **5** must at first be lifted out of tank **3** by means of a protective carrier hoist that has not been illustrated herein and that is either stationary or mounted to the transport carriage, the processing fluid remaining in the tank **3**. After the lifted and largely emptied protective carrier **5** has received the work pieces **1**, the protective carrier **5** is lowered, together with the work pieces **1**, into tank **3**. Depending on the speed at which the protective carrier **5** is lowered, the processing fluid is controlledly circulated into the protective carrier **5** during the lowering process or, at higher lowering speed, by the resulting difference in the fluid levels inside and outside the protective carrier **5**.

Fig. 2 shows a processing station **10** with a tank with a stationary protective carrier **5** in a way similar to that in **Fig. 1** (tank **3'**), the processing station **10** having a reservoir **25** which is directly mounted to the tank. The minimum amount of fluid the reservoir **25** holds can be less than what it can actually hold since it is not necessary that the entire contents of the tank be transferred by

pumping. For a lowering of the work pieces **1** into the tank in accordance with the invention, the processing fluid is only pumped off until a residual bath level remains, which level reaches just underneath the lower edge of the work pieces **1** entered into the protective carrier **5**.

Fig. 3 shows an empty tank **24** and a processing station **10** comprising a tank **3** which is filled with processing fluid and is assigned a protective carrier **5**. The processing station **10** is equipped with a protective carrier hoist (not shown) that is assigned to tank **3** and that is capable of vertically moving the protective carrier **5** up and down in the direction of arrow **26**. The up and down path approximately corresponds to the up and down movement of the flight bar **2** holding the work pieces **1**.The flight bar **2** is taken there in its upper position by means of the transport carriage. Then, the protective carrier **5** is lifted in the upper position and thereby receives the work pieces **1** inside thereof. At this instant of time, there is hardly any processing fluid in the protective carrier **5**. Then, the protective carrier **5** and the work pieces **1** are slowly and almost synchronously lowered into the tank **3** until an intended position is reached. To remove the work pieces **1** after treatment, the protective carrier **5** remains in the lower position and only the flight bar **2** holding the work pieces **1** exits the station by means of the hoist of the transport carriage.

The processing station of **Fig. 4** is shown horizontally rotated 90 degrees as compared to the preceding figures so that the processing station is visible from the loading side of the electroplating plant. The protective carrier hoist is associated with a transport carriage shown in fragments. In this embodiment, the protective carrier **5** is equipped on either side with guiding supports **11** which rest in the lowered position on the bearing surfaces **12** on the rim of the tank **3**, thus carrying the protective carrier **5**. Carrying arms **17** are further mounted to the protective carrier **5** by which the transport carriage, which is shown in fragments only, can vertically raise the protective carrier **5** by means of the receiving arms **18** and the traction system **20**. In this embodiment, the transport carriage has two hoists, a work piece hoist and a protective carrier

hoist. The general parts of the hoists, such as a winding spindle, a lift gear motor, guides for the protective carrier and so on, which do not serve to describe in closer detail the way the invention functions, have not been illustrated herein. The work pieces **1** are fastened to the flight bar **2** by means of the holding devices **4**. The flight bar **2** has carrying arms **23** by which the work piece hoist or the flight bar hoist takes hold of the flight bar **2** by means of the receiving arms **22** and can raise or lower it. It will be placed on guiding supports **13** provided on the flight bar and on bearing surfaces **14** provided on a carrying device for the protective carrier. The transport carriage conveys the work pieces **1** in lifted position to the processing station with tank **3**. Then, the protective carrier hoist, the receiving arms **18** of which have been placed beneath the carrying arms **17**, raises the protective carrier **5** by means of a traction system **20** until the work pieces **1** are completely located therein. The work piece hoist has the lifting beam **15** and the protective carrier hoist a lifting beam **16**. The arrows **26** designate the pulling direction for the work pieces.

As the protective carrier **5** is lifted, the processing fluid contained therein exits the protective carrier **5** through the apertures **6** and flows back into tank **3**. For fast evacuation of the fluid from the protective carrier **5**, drain baffles **27** are provided in the bottom of the protective carrier, which automatically open during the lifting process for example through the lift motion by way of lever rods (not shown) or through floats and which close automatically again through the lowering motion. The way the drain baffles are moving has not been illustrated in the figures.

After the protective carrier **5** has been emptied and has reached the upper position, the transport carriage slowly and synchronously lowers the protective carrier and the flight bar simultaneously *i.e.*, at almost the same speed, into the tank **3** using the work piece hoist and the protective carrier hoist. As the processing fluid held in tank **3** is displaced, the bath level **21** is raised outside the protective carrier **5** and the fluid flows at controlled speed into the protective carrier **5** according to the configuration of the apertures **6**.

Numerals:

1	work pieces
2	flight bar
3	tank for treatment in a fluid (working tank)
4	holding device for holding the work pieces on the flight bar
5	protective carrier
6	apertures for entrance and exit of the processing fluid
7	reservoir
8	pump
9	conduit
10	processing station
11	guiding supports on the protective carrier
12	bearing surfaces on the processing station
13	guiding supports on the flight bar
14	bearing surfaces on the carrying device of the protective carrier
15	lifting beam on the work piece hoist of the transport carriage
16	lifting beam on the protective carrier hoist of the transport carriage
17	carrying arms on the carrying device of the protective carrier
18	receiving arms of the lifting beam of the protective carrier
19	traction system of the work piece hoist
20	traction system of the protective carrier hoist
21	bath level
22	receiving arms of the work piece lifting beam
23	carrying arms on the flight bar
24	tank for dry treatment
25	reservoir
26	direction of movement of the protective carrier and of the flight bar
27	drain baffle